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NATIONAL DAM INSPECTION PROGRAM. LOWER DAM (NDS I.D. NUMBER PA--ETC(U)
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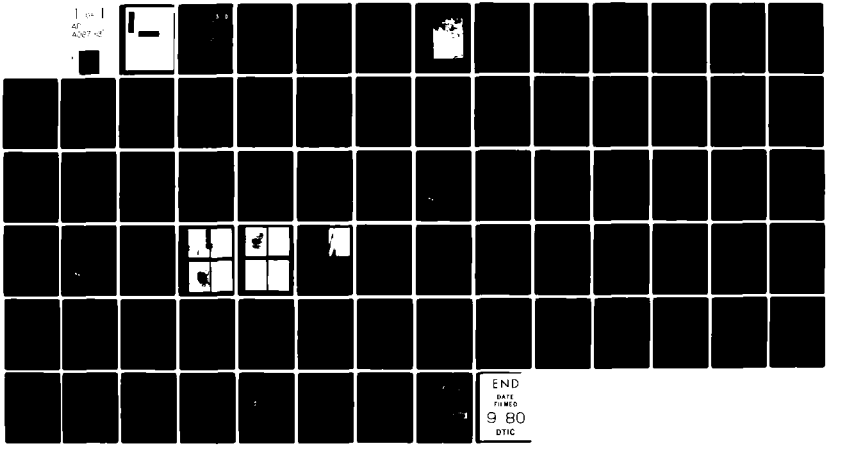

L. ROBERT KIMBALL & ASSOCIATES
DACW31-80-C-0020

DELAWARE RIVER BASIN,
SILFIS RUN, SCHUYLKILL COUNTY,
PENNSYLVANIA

National Dam Inspection Program

LOWER DAM

NDS ID No. PA-697,
DER ID No. 54-47

ORWIGSBURG WATER AUTHORITY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

(15) DACW31-80-C-0058

(11) Jul 80

(12) 75

Prepared By

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CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG, PENNSYLVANIA
15931

FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

JULY, 1980

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in detemining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION REPORT

NAME OF DAM	Lower Dam
STATE LOCATED	Pennsylvania
COUNTY LOCATED	Schuylkill
STREAM	Silfis Run
DATE OF INSPECTION	November 16 and 19, 1979

ASSESSMENT

The assessment of Lower Dam is based upon visual observations made at the time of inspection, review of available records and data, hydraulic and hydrologic computations and past operational performance.

Lower Dam is a high hazard-intermediate size dam. The spillway design flood (SDF) is the PMF (Probable Maximum Flood).

The existing spillway and reservoir are capable of controlling approximately 15% of the PMF. Based on criteria established by the Corps of Engineers, the spillway is termed inadequate. If Lower Dam should fail due to overtopping, the hazard to loss of life and property downtream from the dam would not be significantly increased from that which would exist just prior to overtopping.

Extensive seepage is exiting through or beneath the dam. In addition, the embankment or foundation materials may be piping due to the excessive seepage. The dam appears to be in poor condition. As a result, the dam is considered an unsafe, non-emergency dam.

The following recommendations and remedial measures should be instituted immediately.

1. A stability and seepage analysis should be conducted of the embankment. A determination should be made as to the presence and/or potential for embankment and foundation piping and necessary action taken to control the seepage, as required.

2. Perform additional studies by a registered professional engineer knowledgeable in dam design and inspections for modification of the spillway and/or embankment to increase spillway capacity and upgrade the structural condition of the wingwalls and control section.

3. The seepage and wet areas located on the downstream slope and at the toe of the embankment should be monitored at regular intervals and during periods of heavy precipitation.

The monitoring program and monitor readings should be evaluated by a professional engineer experienced in dam design and construction.

4. The brush should be cleared from the embankment slopes and spillway exit channel. Trees growing of the right spillway abutment should be removed.

5. Some means of positive upstream closure of the drainline should be developed for use in case of emergencies.

6. The outlet works should be operated and lubricated on a regular basis.

7. Slope protection should be provided on the upstream slope to check erosion where it exists or develops.

8. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.

9. A safety inspection should be implemented with inspections at regular intervals by qualified personnel.

SUBMITTED BY:

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS AND ARCHITECTS

Date

R. Jeffrey Kimball, P.E.

APPROVED BY:

11 July 1980

Date

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Overview of Lower Dam.

TABLE OF CONTENTS

APPENDICES

PHASE I
NATIONAL DAM INSPECTION PROGRAM
LOWER DAM
NDI. I.D. NO. PA 679
DER I.D. NO. 54-47

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Lower Dam is an earthfill dam, 360 feet long and 40 feet high. The crest width is 10 feet. The upstream slope above the water level is 1H:1V and grass covered. The downstream slope is 2H:1V and grass covered. The embankment reportedly has a concrete cutoff extending from bedrock to the crest of the dam.

A pump house is located at the toe of dam which regulates flow through a 10" cast iron pipe. Immediately downstream of the dam is a small catch basin reservoir which collects seepage exiting through and under Lower Dam. This reservoir creates tailwater on the downstream slope of the Lower Dam. Upstream of Lower Dam and in the reservoir, an abandoned timber crib dam is located. At normal pool (elevation 800.0) just the top of dam can be seen.

A 6" steel pipe extends from the catch basin reservoir at the toe of dam over the Lower Dam crest and into the Lower Dam reservoir. Seepage water is pumped from the catch basin into the Lower Dam.

The spillway is located on the right abutment and consists of an open cut with a masonry wingwall separating the spillway from the embankment. The spillway weir bottom and discharge channel bottom are masonry paved. The spillway weir is 29 feet long. The discharge channel bypasses the seepage collection pond.

b. Location. The dam is located on Silfis Run, approximately 1 1/2 miles northwest of Orwigsburg, Schuylkill County, Pennsylvania. Lower Dam can be located on the Orwigsburg, U.S.G.S. 7.5 minute quadrangle.

c. Size Classification. Lower Dam is an intermediate size dam (40 feet high, 26 ac-ft).

d. Hazard Classification. Lower Dam is a high hazard dam. Downstream conditions indicate that loss of more than a few lives is probable should the structure fail. One dwelling is located approximately 4,000 feet downstream of Lower Dam on Mahannon Creek and several dwellings are located 6,000 feet downstream of the dam.

e. Ownership. Lower Dam is owned by Orwigsburg Water Authority. Correspondence should be addressed to:

George Zimmer, Manager
Orwigsburg Water Authority
Borough Hall
Orwigsburg, PA 17961
(717) 366-2285

f. Purpose of Dam. Lower Dam is used for water supply.

g. Design and Construction History. No information is available on the original design and construction of the dam. The dam was built in 1896 and Borough officials said they had continuous trouble with leakage through and under the dam. The original dam was reportedly designed by W.S. Pugh of Pottsville, Pennsylvania. In 1923 a trench was excavated through the embankment along the crest of the dam to construct a concrete corewall. This corewall extended from bedrock to within 1 to 2 feet of the top of dam. The material excavated from the trench was dumped on the downstream slope of the dam and loose, permeable layers were reportedly found during the excavation. Approximately 1968, an attempt was made to grout the dam by pumping fly ash into the embankment. No information is available on this work.

The Upper Silfis Run Dam (submerged timber crib dam) was constructed in 1883 and used for water supply. This reservoir is no longer active. The catch basin reservoir at the toe of Lower Dam was built in 1935 to 1936 to collect seepage from the Lower Dam.

h. Normal Operating Procedures. The reservoir water level is maintained at the spillway crest elevation, whenever possible. Flow through the 10" cast iron pipe is regulated by the valve house located at the toe of dam. Because of extensive seepage through and under Lower Dam the catch basin reservoir was constructed. From the hours between 6:30 a.m. and 3:30 p.m. the seepage water stored in the catch basin is pumped back into Lower Dam. The pumps are shut off at 3:30 p.m. Between 3:30 p.m. and 6:30 a.m. the catch basin reservoir is filled by seepage water through the Lower Dam. Before 6:30 a.m. the reservoir is filled by seepage and water is discharging through the spillway of the catch basin reservoir.

1.3 Pertinent Data.

a. Drainage Area. 0.73 square miles

b. Discharge at Dam Site (cfs).

Maximum known flood at dam site	Unknown
Drainline capacity at normal pool	Unknown
Spillway capacity at top of dam	230

c. Elevation (U.S.G.S. Datum) (feet). - Based on spillway crest elevation interpolated from U.S.G.S. 7.5 minute quadrangle.

Top of dam - low point	801.9
Top of dam - design height	Unknown
Maximum pool - design surcharge	Unknown
Full flood control pool	N/A
Normal pool	800.0
Spillway crest	800.0
Upstream portal - 10" CIP	Unknown
Downstream portal - 10" CIP	Unknown (below tailwater)
Streambed at centerline of dam	Approximately 762.0
Maximum tailwater	Approximately 768
Toe of dam	Approximately 762.0

d. Reservoir (feet).

Length of maximum pool	400 feet
Length of normal pool	300 feet

e. Storage (acre-feet).

Normal pool	22
Top of dam	26

f. Reservoir Surface (acres).

Top of dam	2.0
Normal pool	1.8
Spillway crest	1.8

g. Dam.

Type	Earth embankment
Length	360 feet
Height	40 feet
Top width	10 feet
Side slopes - upstream	1H:1V
- downstream	2H:1V

Zoning	Unknown
Impervious core	Concrete corewall
Cutoff	Concrete corewall to rock
Grout curtain	Unknown

h. Reservoir Drain.

Type	10" CIP
Length	Approximately 150'
Closure	Valve at toe
Access	Valve in valve house at toe
Regulating facilities	Valve in valve house at toe

i. Spillway.

Type	Open cut with masonry wingwall
Length	29 feet
Crest elevation	800.0
Upstream channel	Lake
Downstream channel	Masonry spillway exit channel

SECTION 2
ENGINEERING DATA

2.1 Design. The owner did not provide any design or construction data on the dam. The Commonwealth of Pennsylvania, Department of Environmental Resources supplied some back-up data pertaining to general statistics of the dam, correspondence, permits and photographs for this structure. All this information was reviewed to complete this report.

2.2 Construction. No information exists on construction of the dam.

2.3 Operation. No operating records are maintained.

2.4 Evaluation.

a. Availability. Engineering data was provided by PennDER, Bureau of Dams and Waterways Management and through interviews with the owner. The manager of the water authority was interviewed to obtain data on operation of maintenance of the dam.

b. Adequacy. Detailed analyses cannot be made because of the lack of detailed design information. This Phase I Report is based upon available data, visual inspection and hydrologic and hydraulic analyses. Sufficient information exists to complete a Phase I report.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The onsite inspection of Lower Dam was conducted by personnel of L. Robert Kimball and Associates on November 16 and 19, 1979. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments and toe.
2. Examination of the spillway facilities, exposed portion of any outlet works and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.
4. Evaluation of the downstream area hazard potential.

b. Dam. The dam appeared to be in poor condition. From a brief survey conducted during the inspection, it was noted that a low spot exists on the embankment toward the right abutment. The crest width of the dam was measured to be 10 feet. The upstream slope above the water level was measured at 1H:1V and covered with grass. Most of the upstream slope above the water level was not protected with riprap. The downstream slope was measured at 2H:1V and covered with grasses and brush. An extensive wet area and seepage area was located on the downstream slope near the maximum section. The top of this wet area was measured at elevation 776.7. Seepage exiting from this wet area is flowing down the downstream slope of the dam to a pathway near the toe of dam. The seepage is then flowing down the pathway into the catch basin reservoir. In addition, an area of ponded water at the toe of dam is located on the right abutment (See page A-12 for seepage and wet area locations). According to Mr. Zimmer, Manager of the Water Authority, an 8" terra-cotta pipe is located below the tailwater of Lower Dam. This 8" terra-cotta pipe carries a large amount of seepage exiting from Lower Dam. In addition, Mr. Zimmer indicated that the terra-cotta pipe is partially filled with sand (which may indicate some piping of embankment or foundation materials). The catch basin reservoir is pumped dry during daylight hours by pumping water back into the Lower Dam Reservoir and seepage fills the catch basin again during night time hours. It is estimated that seepage from Lower Dam is equivalent to 1.5 million gallons in 15 hours (1,666 gallons per minute). Mr. Zimmer indicated that it is his opinion that the seepage is increasing.

c. Appurtenant Structures. The spillway is located on the right abutment and consists of an open cut spillway with a masonry bottom and a masonry wingwall separating the embankment from the spillway. The spillway appears to be in good condition.

The 10" cast iron outlet works pipe was not observed nor the valves operated during the inspection. No upstream closure is provided on these pipes.

d. Reservoir Area. The watershed is covered mostly with steep woodland. The reservoir slopes are moderately steep but do not appear to be susceptible to landslides which would affect storage volume of the reservoir or overtopping of the dam by displacing water.

e. Downstream Channel. Silfis Run downstream of Lower Dam is narrow for approximately 2,000 feet until it meets Mahannon Creek. One home is located approximately one-half mile downstream of the dam.

3.2 Evaluation. In general, the embankment is in poor condition and the appurtenant structures are in fair condition.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures. The reservoir is maintained at spillway crest elevation 800, when possible. The reservoir drain was last operated in the spring of 1979. The excess inflow discharges over the spillway crest. Seepage through and under Lower Dam enters the catch basin reservoir and is pumped back into Lower Dam Reservoir once each day.

4.2 Maintenance of the Dam. No planned maintenance schedule exists. Maintenance of the dam is performed by the Water Authority staff. Maintenance of the dam is considered poor.

4.3 Maintenance of Operating Facilities. The maintenance of the spillway and outlet works is considered fair.

4.4 Warning System in Effect. There is no warning system in effect to warn downstream residents of large spillway discharges or imminent failure of the dam.

4.5 Evaluation. Maintenance of the dam is considered poor. Maintenance of the operating facilities is considered fair. There is no system in effect to warn downstream residents of large spillway discharges of imminent failure of the dam.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. No calculations or design data pertaining to hydrology or hydraulics were available.

b. Experience Data. No rainfall, runoff or reservoir level data were available. The spillway reportedly has functioned adequately in the past.

c. Visual Observations. The spillway appeared to be in fair condition. The outlet works pipe and valves were not observed or operated during the inspection.

A low spot (801.9 feet) was noted on the embankment near the right abutment.

d. Overtopping Potential. Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version systemized computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California, July, 1978. The major methodologies or key input data for this program are discussed briefly in Appendix D.

5.2 Evaluation Assumptions. To enable us to complete the hydraulic and hydrologic analysis for this structure, it was necessary to make the following assumptions.

1. Pool level in the reservoir prior to the storm is at the spillway crest elevation 800.0.

2. The top of dam was considered the low spot at elevation 801.9. Variations in the crest elevations will be investigated by the $L, $V (HEC-1) option.

3. The embankment soils appeared to be highly susceptible to erosion and based on the evaluating engineers judgement a pool elevation of 802.1 was sufficient to cause failure by overtopping.

5.3 Summary of Overtopping Analysis. Complete summary sheets for the computer output are presented in Appendix D.

Peak inflow (PMF)	1781 cfs
Spillway capacity	230 cfs

a. Spillway Adequacy Rating. The Spillway Design Flood is based on the hazard and size classification of the dam. The recommended spillway design flood (SDF) for an intermediate size dam is the PMF. Based on the following definition provided by the Corps of Engineers, the spillway is rated as inadequate as a result of our hydrologic analysis.

> Inadequate - All high hazard dams which do not pass the SDF (PMF) but where failure due to overtopping does not significantly increase the hazard potential for loss of life downstream.

The spillway and reservoir are capable of controlling approximately 15% of the PMF without overtopping the embankment.

5.4 Summary of Dam Breach Analysis. As the subject dam cannot satisfactorily pass 50% of the PMF (based on our analysis) it was necessary to perform a dam breach analysis and downstream routing of the flood wave. This analysis determined the degree of increased flooding due to dam failure. The results of the dam breach analysis indicate that downstream flooding is not significantly increased. Since flooding downtream is not significantly increased due to dam failure, according to the Corps of Engineers definitions the spillway is not considered seriously inadequate. Therefore, the spillway is rated as "inadequate".

Details of dam breach analysis appear in Appendix D.

Note: Future development within the watershed, at the dam, or downstream may change the characteristics and assumptions made for this study and different results are likely. Future development downtream may also increased potential for loss of life due to failure of the structure.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. An extensive wet and seepage area was noted on the downstream slope of the embankment. The top of this wet area was approximately 12' above the tailwater elevation. Most of this seepage is exiting from below the tailwater through an 8" terra-cotta pipe. Seepage through the embankment was estimated at greater than 1,666 gallons per minute. According to the manager of the Water Authority, the seepage appears to be increasing. The seepage continues to persist despite efforts to grout the embankment and installation of the concrete corewall. In addition, Mr. Zimmer of the Water Authority stated that the 8" terra-cotta pipe is partially filled with sand. The large volume of seepage and the presence of the sand indicates that piping of the embankment or the foundation materials may be present.

The stability of the embankment is questionable due to the possible high phreatic water surface elevation. The general wet condition of the downstream slope was observed to extend from the toe to mid-way up the downstream embankment slope (See Page A-12).

b. Design and Construction Data. No design or construction data is available. No stability analysis have been conducted for this dam.

c. Operating Records. No operating records are maintained.

d. Post Construction Changes. A concrete corewall was installed in 1923. An attempt was made around 1968 to pump fly ash into the embankment to seal some of the leakage. No data is available on these changes.

e. Seismic Stability. The dam is located in seismic zone 1. No seismic stability analyses has been performed. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The dam appears to be in poor condition and poorly maintained. The outlet works and spillway appear to be in fair condition. The downtream slope showed an extensive wet and seepage area. Extensive seepage was exiting from below the tailwater. The seepage exiting from the dam is greater than 1,667 gallons per minute. The presence of the sand in the terra-cotta pipe indicates that piping of the embankment or the foundation may be occurring due to the large quantity of seepage. The visual observations, review of available data, hydrologic and hydraulic calculations, past operational performance indicate that Lower Dam's spillway is inadequate. The spillway is capable of controlling 15% of the PMF without overtopping the embankment. No adequate stability analysis have been performed for this structure.

b. Adeqacy of Information. Sufficient information is available to complete a Phase I Report.

c. Urgency. The recommendations suggested below should be implemented immediately.

d. Necessity for Further Investigation. In order to accomplish some of the recommendations/remedial measures outlined below, further investigations will be required.

7.2 Recommendations/Remedial Measures.

1. A stability and seepage analysis should be conducted of the embankment. A determination should be made as to the presence and/or potential for embankment and foundation piping and necessary action taken to control the seepage, as required.

2. Perform additional studies by a registered professional engineer knowledgeable in dam design and inspections for modification of the spillway and/or embankment to increase spillway capacity and upgrade the structural condition of the wingwalled and control section.

3. The seepage and wet areas located on the downstream slope and at the toe of the embankment should be monitored at regular intervals and during periods of heavy precipitation. The monitoring program and monitor readings should be evaluated by a professional engineer experienced in dam design and construction.

4. The brush should be cleared from the embankment slopes and spillway exit channel. Trees growing of the right spillway abutment should be removed.

5. Some means of positive upstream closure of the drainline should be developed for use in case of emergencies.

6. The outlet works should be operated and lubricated on a regular basis.

7. Slope protection should be provided on the upstream slope to check erosion where it exists or develops.

8. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.

9. A safety inspection should be implemented with inspections at regular intervals by qualified personnel.

APPENDIX A
CHECKLIST, VISUAL INSPECTION, PHASE I

CHECK LIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Lower Dam COUNTY Schuylkill STATE Pennsylvania ID# 679

TYPE OF DAM Earthfill HAZARD CATEGORY High

DATE(s) INSPECTION November 16 and 19, 1979 WEATHER Clear and cool TEMPERATURE 45°

POOL ELEVATION AT TIME OF INSPECTION 800.1 M.S.L. TAILWATER AT TIME OF INSPECTION 765.0 M.S.L.

INSPECTION PERSONNEL:

R. Jeffrey Kimball, P.E. - L. Robert Kimball and Associates

James T. Hockensmith - L. Robert Kimball and Associates

O.T. McConnell - L. Robert Kimball and Associates

Mr. Zimmer - Orwigsburg Municipal Water Authority

James T. Hockensmith
RECORDER

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None noted.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None noted.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None noted.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal alignment appears to be good. Low spot on embankment crest near right abutment.	
RIPRAP FAILURES	Additional riprap needs to be placed on the upstream slope.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Grass and brush on upstream and downstream slopes and in spillway exit channel.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Appears to be good.	
ANY NOTICEABLE SEEPAGE	Extensive wet area and seepage area on downstream slope, see page A-12. Seepage estimated at greater than 1,667 gallons per minute.	
STAFF GAUGE AND RECORDER	None.	
DRAINS	None.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	Not applicable.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Not applicable.	
DRAINS	Not applicable.	
WATER PASSAGES	Not applicable.	
FOUNDATION	Not applicable.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Not applicable.	
STRUCTURAL CRACKING	Not applicable.	
VERTICAL AND HORIZONTAL ALIGNMENT	Not applicable.	
MONOLITH JOINTS	Not applicable.	
CONSTRUCTION JOINTS	Not applicable.	
STAFF GAUGE OR RECORDER	Not applicable.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	10" cast iron pipe unobserved during inspection.	
INTAKE STRUCTURE	Unknown.	
OUTLET STRUCTURE	Valve house and valve at toe of dam.	
OUTLET CHANNEL	Silfis Run.	
EMERGENCY GATE	At toe of dam.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Masonry weir appears to be in fair condition.	
APPROACH CHANNEL	Lake.	
DISCHARGE CHANNEL	Exit channel has masonry bottom. In fair condition.	
BRIDGE AND PIERS	None.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not applicable.	
APPROACH CHANNEL	Not applicable.	
DISCHARGE CHANNEL	Not applicable.	
BRIDGE AND PIERS	Not applicable.	
GATES AND OPERATION EQUIPMENT	Not applicable.	

DOWNSTREAM CHANNEL

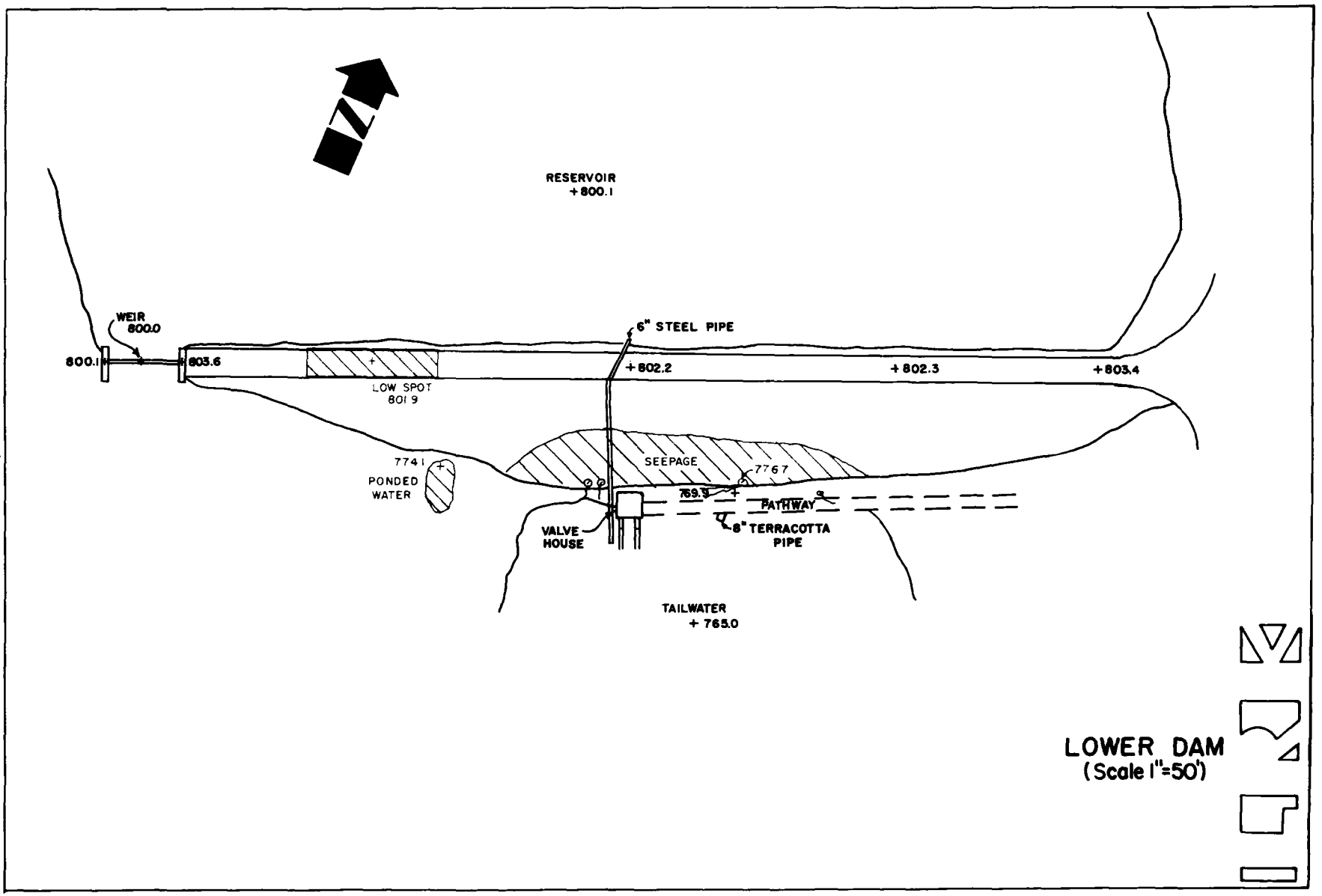
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Silfis Run is narrow for approximately 2,000 feet before entering Mahannon Creek. Mahannon Creek is moderately wide.	
SLOPES	Steep but appear to be stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	Four homes, fifteen people within 1 1/2 miles of the dam.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Moderately steep but appear to be stable.	
SEDIMENTATION	Does not appear to be excessive.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	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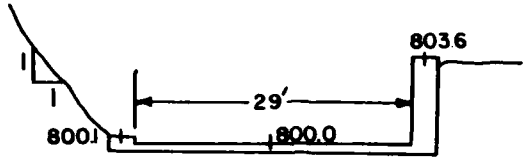
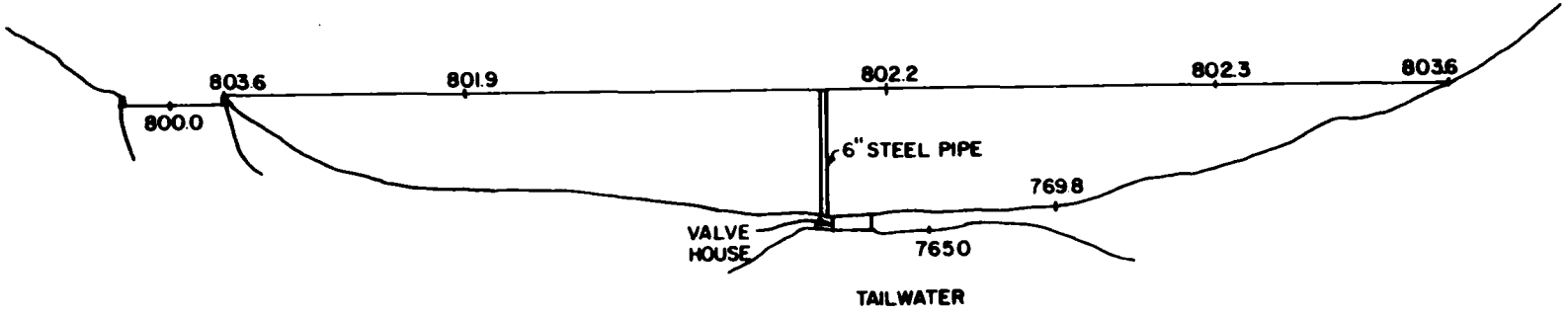
WEIR
800.0
800.1
803.6
LOW SPOT
801.9
6" STEEL PIPE
+802.2
+802.3
+803.4
7741
PONDED
WATER
SEEPAGE
7767
769.3
PATHWAY
VALVE
HOUSE
8" TERRACOTTA
PIPE
TAILWATER
+765.0
LOWER DAM
(Scale 1"=50')



SPILLWAY PROFILE
(Not to Scale)



PROFILE
LOOKING UPSTREAM
(Scale: 1"=50')

LOWER DAM

A-13

APPENDIX B
CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION, OPERATION, PHASE I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Lower Dam

ID# PA 679

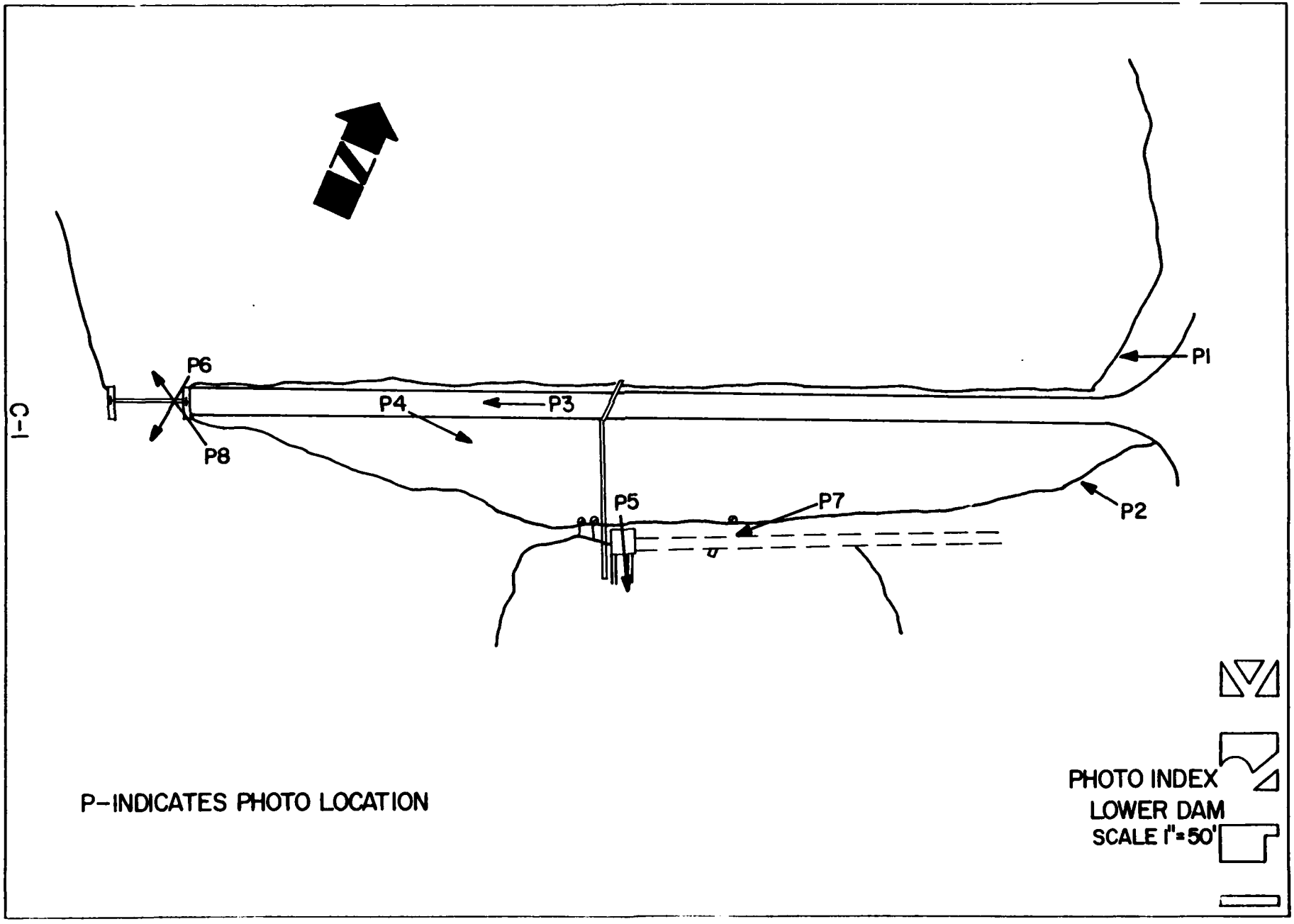
ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	U.S.G.S. quadrangle.
CONSTRUCTION HISTORY	Very sketchy, contained in DER files.
TYPICAL SECTIONS OF DAM	None.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS RAINFALL/RESERVOIR RECORDS	None. None. None. None. None.

ITEM	REMARKS
DESIGN REPORTS	None.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Unknown.
POST-CONSTRUCTION SURVEYS OF DAM	Unknown.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Concrete corewall added and attempt made to grout the embankment to fly ash.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Unknown.
MAINTENANCE OPERATION RECORDS	None.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	None.
OPERATING EQUIPMENT PLANS & DETAILS	None.

APPENDIX C
PHOTOGRAPHS


P6
P8
P4
P3
P1
P5
P7
P2
C-1
P-INDICATES PHOTO LOCATION
PHOTO INDEX
LOWER DAM
SCALE 1"=50'

LOWER DAM

Photograph Descriptions

Sheet 1. Front

(1) Upper left - Upstream slope and crest of dam.
(2) Upper right - Downstream slope of dam.
(3) Lower left - Crest of dam looking toward spillway.
(4) Lower right - Downstream slope of dam.

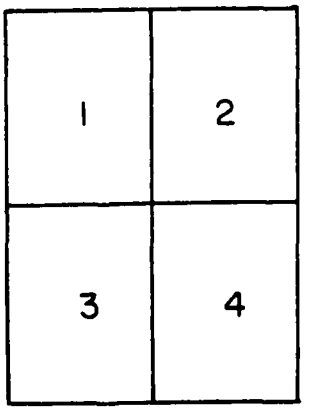
Sheet 1. Back

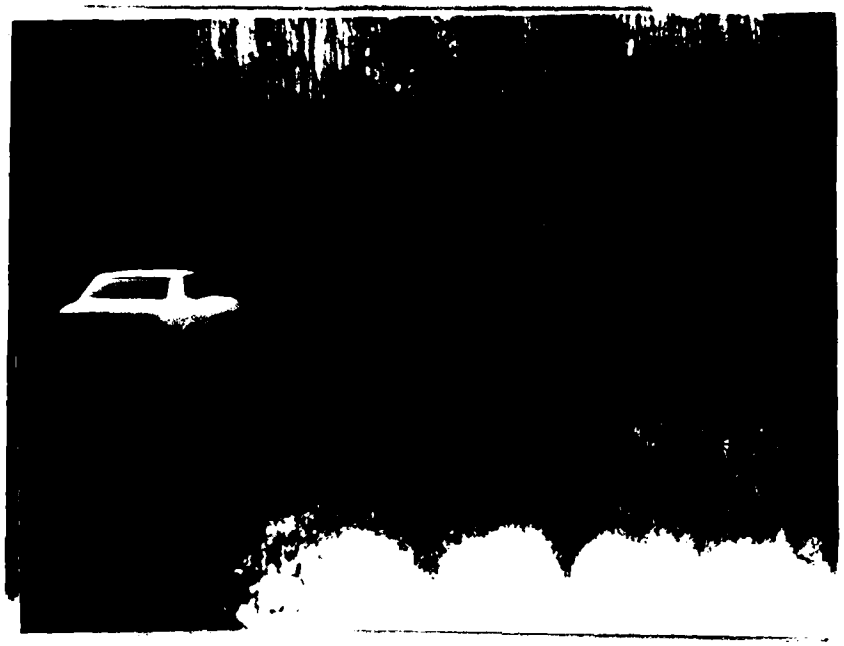
(5) Upper left - Seepage collection pond at toe of Lower Dam.
(6) Upper right - Spillway exit channel.
(7) Lower left - Seepage running along left abutment.
(8) Lower right - Spillway approach at right abutment.

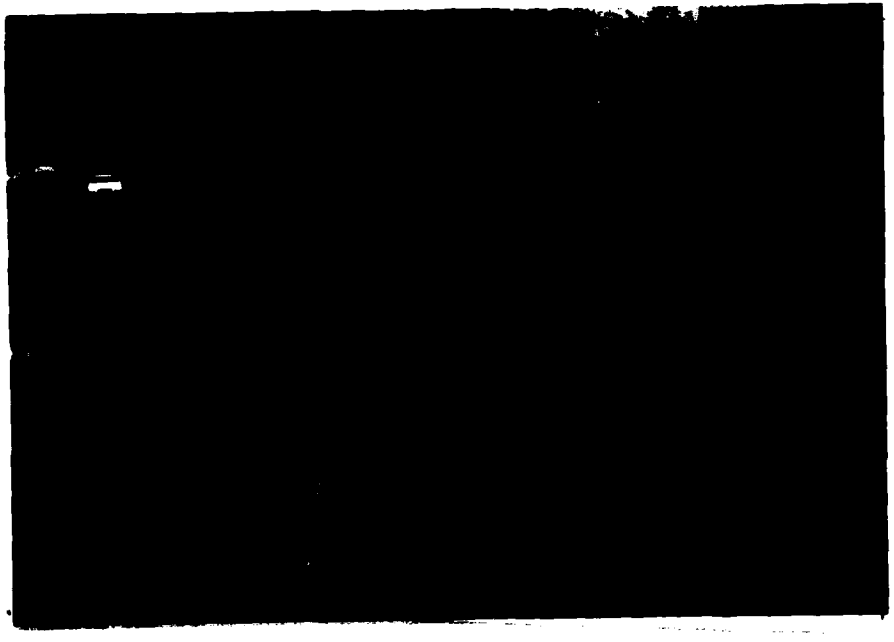
Sheet 2. Front

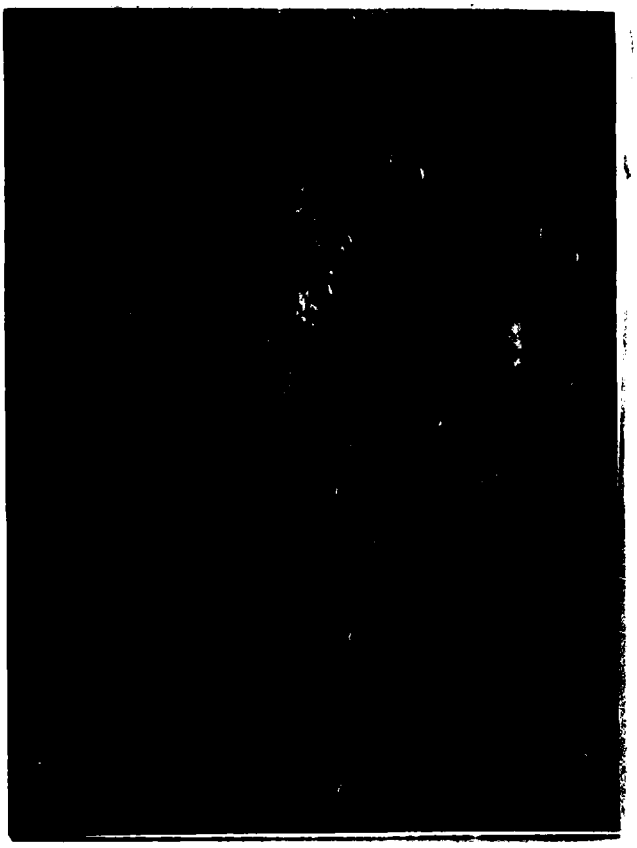
(9) Upper right - Downstream channel below Lower Dam.

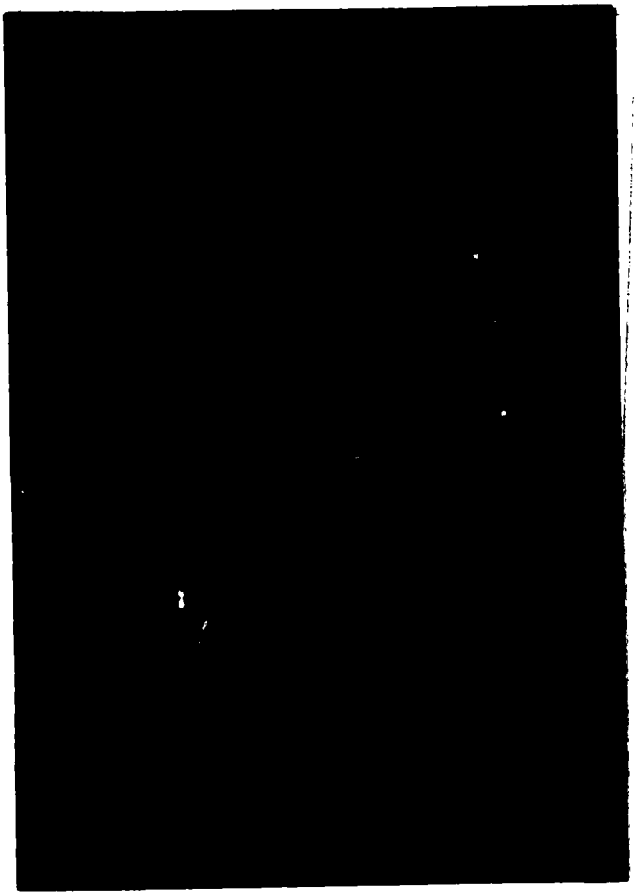
TOP OF PAGE

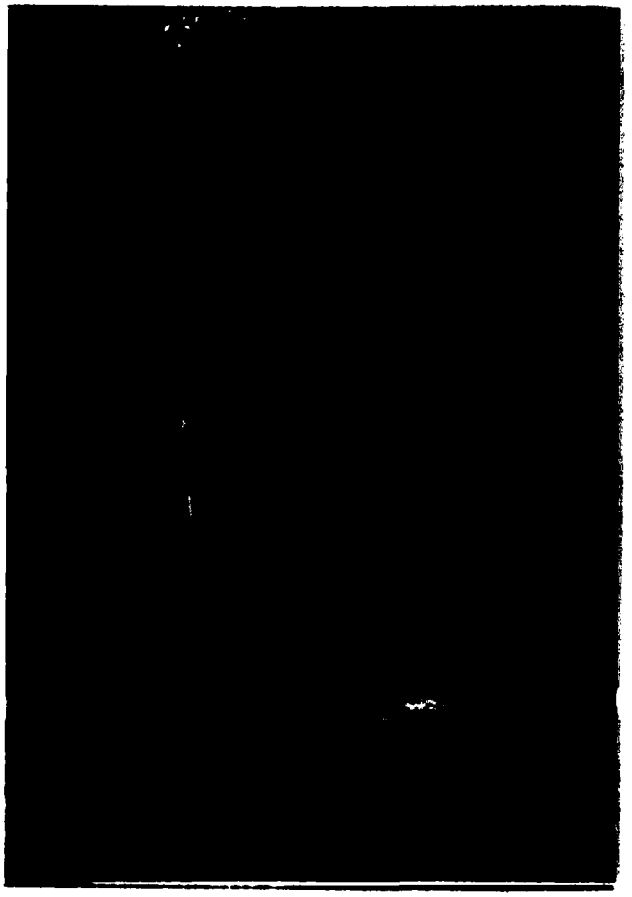












APPENDIX D
HYDROLOGY AND HYDRAULICS

APPENDIX D
HYDROLOGY AND HYDRAULICS

Methodology. The dam overtopping and breach analyses were accomplished using the systemized computer program HEC-1 (Dam Safety Investigation), September, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation. The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 40" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters their definition and how they were obtained for these analysis.

Parameter	Definition	Where Obtained
Ct	Coefficient representing variations of watershed	From Corps of Engineers*
L	Length of main stream channel miles	From U.S.G.S. 7.5 minute topgraphic
Lca	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic
Cp	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 7.5 minute topographic

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

3. Routing. Reservoir routing is accomplished by using Modified Plus routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation discharge relationship.

Storage in the pool area is defined by an area - elevation relationship from which the computer calculates storage. Surface areas are either planimetered from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping. Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

5. Dam Breach and Downstream Routing. The computer program is equipped to determine the increase in downstream flooding due to failure of the dam caused by overtopping. This is accomplished by routing both the pre-failure peak flow and the peak flow through the breach (calculated by the computer with given input assumptions) at a given point in time and determining the water depth in the downstream channel. Channel cross-sections taken from U.S.G.S. 7.5 minute topographic maps were used in the downstream flood wave routing. Pre and post failure water depths are calculated at locations where cross-sections are input.

HYDROLOGY AND HYDRAULICS ANALYSIS
DATA BASE

NAME OF DAM: Lower Dam

PROBABLE MAXIMUM PRECIPITATION (PMP) = 23.1 inches

STATION	1	2	3
Station Description	Lower Dam		
Drainage Area (square miles)	.73		
Cumulative Drainage Area (square miles)	.73		
Adjustment of PMF for Drainage Area (%)(1)			
6 hours	113		
12 hours	123		
24 hours	132		
48 hours	142		
72 hours			
Snyder Hydrograph Parameters			
Zone (2)	6		
Cp (3)	0.40		
Ct (3)	1.35		
L (miles) (4)	1.42		
Lca (miles) (4)	.66		
tp = Ct(LxLca) 0.3 hrs.	1.33		
Spillway Data			
Crest Length (ft)	29'		
Freeboard (ft)	1.9'		
Discharge Coefficient	C'=0.95		
Exponent	N/A		

(1) Hydrometeorological Report 33 (Figure 1), U.S. Army Corps of Engineers, 1965.

(2) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's coefficients (C_p and C_t).

(3) Snyder's Coefficients.

(4) L=Length of longest water course from outlet to basin divide. L_{ca}=Length of water course from outlet to point opposite the centroid of drainage area.

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: D.A=0.73 mi^2

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 22 ac-ft

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 26 ac-ft

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 801.9

SPILLWAY CREST:

a. Elevation 800
b. Type Irregular
c. Width 29'
d. Length Unknown
e. Location Spillover Right abutment
f. Number and Type of Gates None

OUTLET WORKS:

a. Type 10" CIP
b. Location ~~Maximum section~~
c. Entrance inverts Unknown
d. Exit inverts Unknown
e. Emergency draindown facilities 10" CIP

HYDROMETEOROLOGICAL GAUGES:

a. Type None
b. Location None
c. Records None

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

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CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME LOWER DAM
I.D. NUMBER 679
SHEET NO. 1 OF 4
BY CAB DATE 4-16-80

LOSS RATE AND BASE FLOW PARAMETERS

AS RECOMMENDED BY CORPS OF ENGINEERS BALTIMORE DISTRICT.

STRTL = 1 INCH

CNSTL = .05 IN/HR

STRTQ = 1.5 CFS/MI²

QRCSN = .05 (5% OF PEAK FLOW)

RTIOR = 2.0

ELEVATION - AREA - CAPACITY RELATIONSHIPS

FROM USGS 7.5 MIN. QUAD., DER FILES AND FIELD INSPECTION DATA.

SPILLWAY CREST ELEV. = 800.00 ft
POND SURFACE AREA = 1.84 ac
INITIAL STORAGE = 22.0 ac-ft

ELEV. WHERE AREA EQUALS ZERO IS DETERMINED BY THE CONIC METHOD FOR RESERVOIR VOLUME

$H = 3V/A$

$= (3)(22)/1.84$

$= 35.87$

$800 - 35.87 = 764.13$ ft

AT ELEV. 820 AREA EQUALS 5.23 ac

AT ELEV 840 AREA EQUALS 9.46 ac

AREA	$A	0	1.84	5.23	9.64
ELEV.	$E	764.13	800	820	840

OVERTOP PARAMETERS

TOP OF DAM ELEV. = 801.9'
LENGTH OF DAM CREST (EXCLUDING SPILLWAY) = 360'
COEFFICIENT OF DISCHARGE = 3.1

$L	100	155	275	315	362	364
$V	802	802.2	803.5	803.9	804.0	805

377	393
810	815

DISCHARGE RATING CURVE

TRAPEZOIDAL FLOW FROM:

$$Q = 8.03 C' h_v^{1/2} (h_p - h_v)\left[B + z(h_p - h_v)\right]$$

$$h_v = \frac{3(2zh_p + B) - \left(16z^2h_p^2 + 16zBh_p + 9B^2\right)^{1/2}}{10z}$$

$B = 29'$ $z = .5$ $C' = .95$

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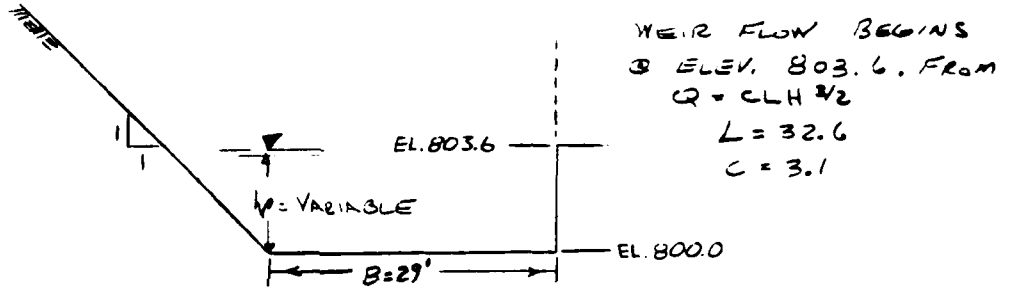
EBENSBURG PENNSYLVANIA

DAM NAME LOWER DAM
I.D. NUMBER 679
SHEET NO. 3 OF 4
BY CAB DATE 4-18-80

FROM: WATER AND WASTEWATER ENGINEERING (11-14), (11-15)
BY: FAIR, GEYER & OKUM 1966

LOW DAMS
BY: NATIONAL RESOURCES COMMITTEE (eq. 7 & 8)
WASHINGTON, D.C. 1938

TRAPEZOIDAL SPILLWAY
(NOT TO SCALE)



ELEV.	TRAPEZOIDAL h_p (ft)	TRAPEZOIDAL Q^* (cfs)	WEIR h_p (ft)	WEIR Q^* (cfs)	Q^*_{TOTAL} (cfs)
800.0	0	0			0
800.5	.5	30			30
801.0	1.0	85			85
801.5	1.5	160			160
801.9	1.9	230			230
802.5	2.5	345			345
803.0	3.0	460			460
803.6	3.6	605			605
804.0			.4	25	630
805.0			1.4	165	770
810.0			6.4	1635	2240

* VALUES ROUNDED TO NEAREST 5 CFS.

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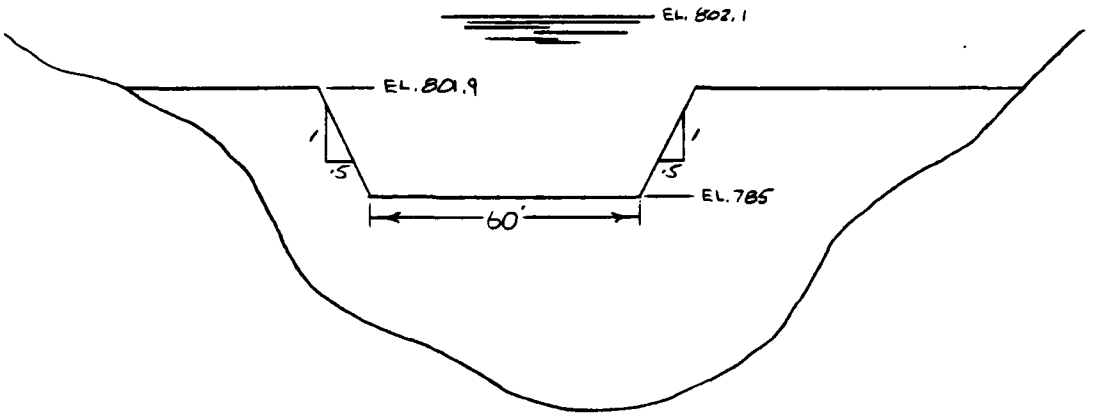
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME LOWER DAM
I.D. NUMBER 679
SHEET NO. 4 OF 4
BY CAB DATE 4-28-80

DAM BREACH PARAMETERS



RATIO OF PMF (RTIO) = .2
SIDE SLOPE (Z) = .5
FAILURE TIME (TFAIL) = 2.0 HRS.
BOTTOM WIDTH (BRWID) = 60'
BOTTOM ELEV. (ELBM) = 785'
FAILURE ELEV. (FAILEL) = 802.1, 805.0
INITIAL WATER ELEV. (WSEL) = 800.0

SB	60	.5	785	2.0	800	802.1
SB	60	.5	785	2.0	800	805.0

CHANNEL ROUTING

CROSS SECTIONS OBTAINED FROM U.S.G.S. 7.5 MIN. QUAD.

MANNING'S n:
CHANNEL = .05
OVERBANK = .06

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79.
**********
    1              A1       ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
    2              A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFTY OF LOWER DAM (679)
    3              A3       RATIOS OF PMF ROUTED THROUGH THE RESERVOIR
    4              B    288       0       10        0        0        0        0        0        0        0
    5              B1     5
    6              J      I       3        1
    7              J1    .1      .2        1
    8              K      0       1                                                  1
    9              K1       INFLOW TO RESERVOIR
   10              M      1       1       .73                                                            1
   11              P             23.10    113      121      132      142
   12              T                                                                                  1      .05
   13              W    1.33     .40
   14              X    -1.5     -.05     2.0
   15              K      1       2                                                  1
   16              K1       ROUTE THROUGH RESERVOIR
   17              Y                                        1        1
   18              YI     I                                                                  800.0      -1
   19              Y4   800.0   800.5    801.0    801.5    801.9    802.5    803.0    803.6    804.0    805.0
   20              Y4   810.0
   21              Y5     0.0    30.0     85.0    160.0    230.0    345.0    460.0    605.0    830.0    770.0
   22              Y52  240.0
   23              SA       0    1.84     5.23     9.64
   24              SE  764.13   800.0    820.0    840.0
   25              SS   800.0
   26              SD   801.9     3.1      1.5     25.0
   27              SL   100.0   155.0    275.0    315.0    362.0    364.0
   28              SV   802.0   802.2    802.5    803.0    804.0    805.0
   29              K       99
```

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN  DATE= 80/04/21.
     TIME= 07.30.11.
```

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFTY OF LOWER DAM (679)
RATIOS OF PMF ROUTED THROUGH THE RESERVOIR

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 3 LRTIO= 1

RTIOS= .10 .20 1.600

****

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.73	0.00	.73	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.10	113.00	121.00	132.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH D
TP= 1.33 CP= .40 TA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 8.28 AND R=14.97 INTERVALS

UNIT HYDROGRAPH 84 END-OF-PERIOD ORDINATES, LAG= 1.34 HOURS, CP= .40 VOL= 1.00

5.	20.	42.	67.	94.	117.	134.	143.	142.	133.
125.	117.	109.	102.	95.	89.	83.	78.	73.	68.
64.	60.	56.	52.	49.	46.	43.	40.	37.	35.
33.	31.	29.	27.	25.	23.	22.	21.	19.	18.
17.	16.	15.	14.	13.	12.	11.	11.	10.	9.
9.	8.	8.	7.	7.	6.	6.	5.	5.	5.
4.	4.	4.	4.	3.	3.	3.	3.	3.	2.
2.	2.	2.	2.	2.	2.	2.	1.	1.	1.
1.	1.	1.	1.						

HYDROGRAPH ROUTING

ROUTE THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-800.	-1

STAGE	800.00	800.50	801.00	801.50	801.90	802.50	803.00	803.60	804.00	805.00
	810.00									
FLOW	0.00	30.00	85.00	160.00	230.00	345.00	460.00	605.00	630.00	770.00
	2240.00									
SURFACE AREA=	0.	2.	5.	10.						
CAPACITY=	0.	22.	90.	236.						
ELEVATION=	764.	800.	820.	840.						

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
800.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
801.9	3.1	1.5	25.

CREST LENGTH AT OR BELOW ELEVATION	10.	155.	275.	315.	362.	364.
	802.0	802.2	802.5	803.0	804.0	805.0

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .20	RATIO 3 1.00
HYDROGRAPH AT	1	.73	1	178.	356.	1781.
	(	1.89)	(	5.04)(	10.09)(	50.43)(
ROUTED TO	2	.73	1	177.	355.	1782.
	(	1.89)	(	5.00)(	10.06)(	50.46)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	800.00	800.00	801.90
	STORAGE	22.	22.	26.
	OUTFLOW	0.	0.	230.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	801.60	0.00	25.	177.	0.00	41.17	0.00
.20	802.27	.37	27.	355.	3.50	41.00	0.00
1.00	803.40	1.50	29.	1782.	10.83	41.00	0.00

```
A1       RATIOS OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM
A2       DOWNSTREAM CONDITIONS DUE TO OVERTOPPING FLOWER DAM 167911
A3       PLAN 1 ASSUMES BREACH, PLAN 2 ASSUMES NO BREACH
B     288                10
B1      5
J       2        1        1
J1    .2
K       0        1                                          1
K1       INFLOW TO RESERVOIR
M       1        1     .73                                                1
P              23.10    113      121      132      142
T                                                          1     .05
W    1.33      140
X    -1.5     -.05      2.0
K       1        2                                          1
K1       ROUTE THROUGH RESERVOIR
Y                                    1        1
Y1      1                                                -800.0       -1
Y4  800.0    800.5    801.0    801.5    801.9    802.5    803.0    803.6    804.0    805.0
Y4  810.0
Y5    0.0     30.0     85.0    160.0    230.0    345.0    460.0    605.0    630.0    770.0
Y52240.0
SA      0     1.84     5.23     9.64
SE 764.13    800.0    820.0    840.0
SS  800.0
SD  801.9      3.1      1.5     25.0
SL  100.0    155.0    275.0    315.0    362.0    364.0
SV  802.0    802.2    802.5    803.0    804.0    805.0
SB     60       .5      785      2.0      800     802.1
SB     60       .5      785      2.0      800      805
K     .1        3                                          1
K1       ROUTE THROUGH CHANNEL REACH 1
Y                                    1        1
Y1      1
Y6    .06      .09      .06      698      740     1500      .05
Y7      0      740       75      720      225      700      227      698      232      698
Y7    234      700      500      780      550      740

K       1        4                                          1
K1       ROUTE THROUGH CHANNEL REACH 2
Y                                    1        1
Y1      1
Y6    .06      .05      .06      608      640     4750      .02
Y7      0      640      110      620      500      610      502      608      507      608
Y7    509      610      650      620      750      640
K       1        5                                          1
K1       ROUTE THROUGH CHANNEL REACH 3
Y                                    1        1
Y1      1
Y6    .06      .05      .06      558      600     3500      .01
Y7      0      600      250      580      700      560      702      558      70       558
Y7    709      560     1100      580     1300      600
```

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN  DATE= 80/04/23.
     TIME= 06.14.22.
```

RATIOS OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM
DOWNSTREAM CONDITIONS DUE TO OVERTOPPING (LOWER DAM (6791))
PLAN 1 ASSUMES BREACH, PLAN 2 ASSUMES NO BREACH

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 2 NRTIO= 1 LRTIO= 1

RTIOS= .20

****

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.73	0.00	.73	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.10	113.00	121.00	132.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 1.33 CP= .40 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= .05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 8.28 AND R=14.97 INTERVALS

UNIT HYDROGRAPH 84 END-OF-PERIOD ORDINATES, LAG= 1.34 HOURS, CP= .40 VOL= 1.00

5.	20.	42.	67.	94.	117.	134.	143.	142.	133.
125.	117.	109.	102.	95.	89.	83.	78.	73.	68.
64.	60.	56.	52.	49.	46.	43.	40.	37.	35.
33.	31.	29.	27.	25.	23.	22.	21.	19.	18.
17.	16.	15.	14.	13.	12.	11.	11.	10.	9.
9.	8.	8.	7.	7.	6.	6.	5.	5.	5.
4.	4.	4.	4.	3.	3.	3.	3.	3.	2.
2.	2.	2.	2.	2.	2.	2.	1.	1.	1.
1.	1.	1.	1.						

D-15

****

HYDROGRAPH ROUTING

ROUTE THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-800.	-1

STAGE	800.00	800.50	801.00	801.50	801.90	802.50	803.00	803.60	804.00
805.00	810.00								
FLOW	0.00	30.00	85.00	160.00	230.00	345.00	460.00	605.00	630.00
770.00	2240.00								
SURFACE AREA=	0.	2.	5.	10.					
CAPACITY=	0.	22.	90.	236.					

D-16

ELEVATION=	764.	800.	820.	840.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
800.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
801.9	3.1	1.5	25.

CREST LENGTH	100.	155.	275.	315.	362.	364.
AT OR BELOW ELEVATION	802.0	802.2	802.5	803.0	804.0	805.0

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
60.	.50	785.00	2.00	800.00	802.10

STATION 2, PLAN 1, RATIO 1

9.4.16

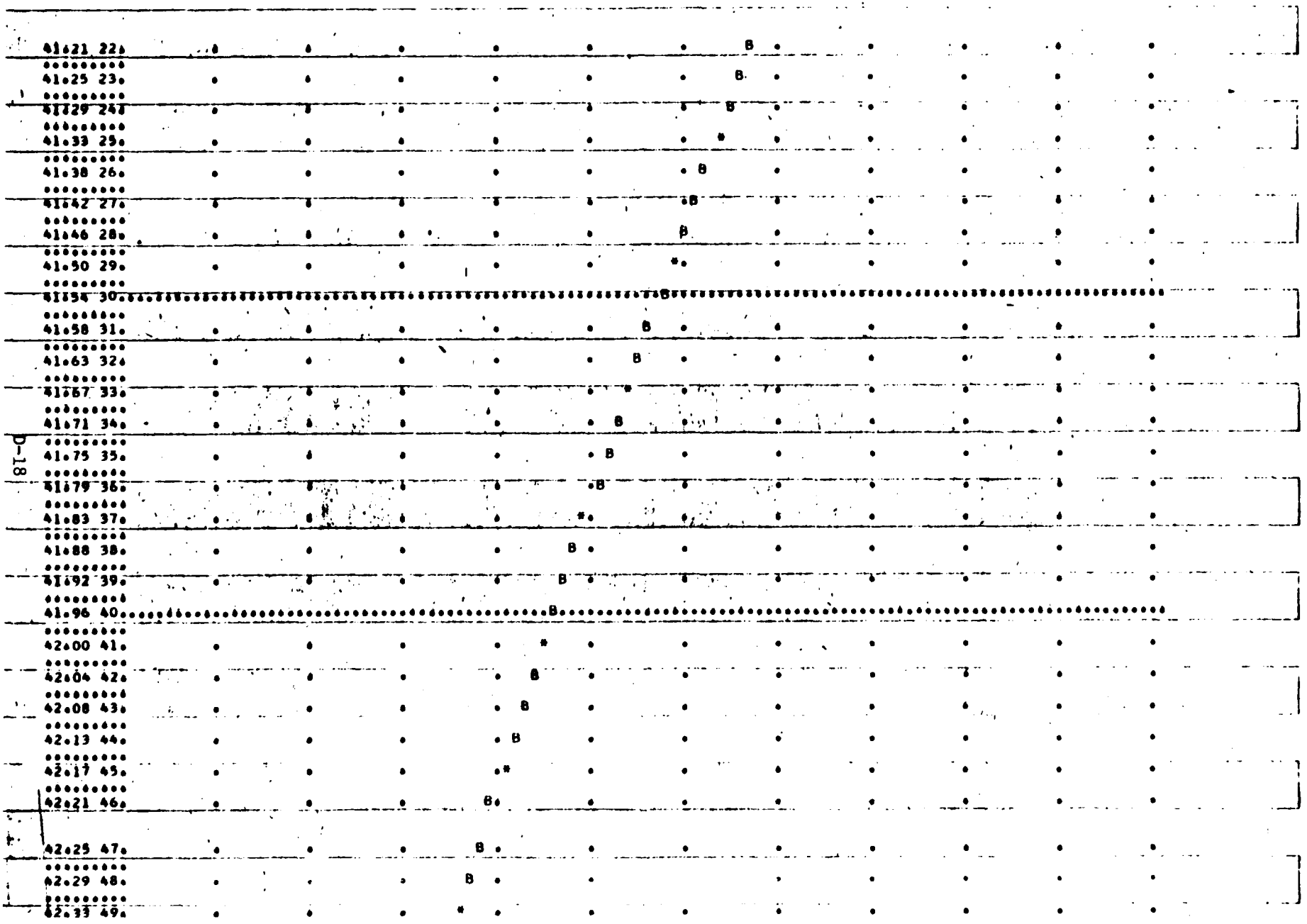
OVF

STATION 2

TIME (HRS) (O) INTERPOLATED BREACH HYDROGRAPH (B) COMPUTED BREACH HYDROGRAPH (*) POINTS AT NORMAL TIME INTERVAL

240. 280. 320. 360. 400. 440. 480. 520. 560. 0. 0. 0.

770.0.
40.33 1.
770.0.
40.38 2.
770.0.
40.42 3.
770.0.
40.46 4.
770.0.
40.50 5.
770.0.
40.54 6.
770.0.
40.58 7.
770.0.
40.63 8.
770.0.
40.67 9.
770.0.
40.71 10.
40.75 11.
40.79 12.
40.83 13.
40.88 14.
40.92 15.
40.96 16.
41.00 17.
41.04 18.
41.08 19.
41.13 20.
41.17 21.


41.21 22
41.25 23
41.29 24
41.33 25
41.38 26
41.42 27
41.46 28
41.50 29
41.54 30
41.58 31
41.63 32
41.67 33
41.71 34
41.75 35
41.79 36
41.83 37
41.88 38
41.92 39
41.96 40
42.00 41
42.04 42
42.08 43
42.13 44
42.17 45
42.21 46
42.25 47
42.29 48
42.33 49

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
60.	.50	785.00	2.00	800.00	805.00

HYDROGRAPH ROUTING

ROUTE THROUGH CHANNEL REACH 1

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	.1000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	698.0	740.0	1900.	.09000

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00	740.00	75.00	720.00	225.00	700.00	227.00	698.00	232.00	698.00
234.00	700.00	300.00	720.00	550.00	740.00				

STORAGE	0.00	.458	3. 3	9.60	19.37	32.64	49.40	69.67	93.44
...120.71									
	151.47	184.40	218.38	253.41	289.49	326.62	364.81	404.05	444.33
...485.67									
OUTFLOW	0.00	138.83	918.03	3278.54	7976.86	15651.24	26874.89	42176.93	62053.59
/86975.25									
	117647.99	159093.02	205943.08	258093.16	315475.72	378049.83	445794.22	518702.55	596780.08
680041.22									
STAGE	698.00	700.21	702.42	704.63	706.84	709.05	711.26	713.47	715.68
...717.89									
	720.11	722.32	724.53	726.74	728.95	731.16	733.37	735.58	737.79
...740.00									
FLOW	0.00	138.83	918.03	3278.54	7976.86	15651.24	26874.89	42176.93	62053.59
686975.25									
	117647.99	159093.02	205943.08	258093.16	315475.72	378049.83	445794.22	518702.55	596780.08
680041.22									

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE THROUGH CHANNEL REACH 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	608.0	640.0	4750.	.02000

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 640.00 110.00 620.00 500.00 610.00 502.00 608.00 507.00 608.00
509.00 610.00 650.00 620.00 750.00 640.00

STORAGE	0.00	1.23	8.29	31.50	71.14	127.19	199.68	288.59	388.88
680492.51									
	599.40	709.54	822.92	939.55	1059.43	1182.55	1308.93	1438.55	1571.42
681707.54									
OUTFLOW	0.00	52.17	338.11	1583.59	4441.88	9440.60	17046.28	27685.98	43776.42
63344.17									
	85946.61	111494.52	139928.42	171209.05	205311.62	242222.07	281934.48	324449.30	369772.00
417912.14									
STAGE	608.00	609.68	611.37	613.05	614.74	616.42	618.11	619.79	621.47
681623.16									
	624.84	626.53	628.21	629.89	631.58	633.26	634.95	636.63	638.32
681640.00									
FLOW	0.00	52.17	338.11	1583.59	4441.88	9440.60	17046.28	27685.98	43776.42
463344.17									
	85946.61	111494.52	139928.42	171209.05	205311.62	242222.07	281934.48	324449.30	369772.00
417912.14									

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE THROUGH CHANNEL REACH 3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	558.0	600.0	3500.	.01000

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 800.00 250.00 580.00 700.00 560.00 702.00 558.00 707.00 558.00
709.00 560.00 1100.00 580.00 1300.00 600.00

STORAGE	0.00	1.35	12.78	40.71	85.16	146.11	223.58	317.55	428.03
681555.03	698.52	854.33	1018.97	1192.45	1374.76	1565.91	1765.88	1974.70	2192.34
682418.82									
OUTFLOW	0.00	62.35	586.53	2458.66	6376.72	12926.43	22632.39	35977.93	53415.83
475374.87	102421.35	137693.41	177991.16	223389.30	273980.34	329868.65	391166.65	457992.36	530467.58
608716.72									
STAGE	558.00	560.21	562.42	564.63	566.84	569.05	571.26	573.47	575.68
682577.89	580.11	582.32	584.53	586.74	588.95	591.16	593.37	595.58	597.79
682600.00									
FLOW	0.00	62.35	586.53	2458.66	6376.72	12926.43	22632.39	35977.93	53415.83
675374.87	102421.35	137693.41	177991.16	223389.30	273980.34	329868.65	391166.65	457992.36	530467.58
608716.72									

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .20
HYDROGRAPH AT	1	.73 (1.89)	1	356. (10.09)
			2	356. (10.09)
ROUTED TO	2	.73 (1.89)	1	530. (15.00)
			2	355. (10.06)
ROUTED TO	3	.73 (1.89)	1	533. (15.09)
			2	355. (10.05)
ROUTED TO	4	.73 (1.89)	1	506. (14.34)
			2	347. (9.83)
ROUTED TO	5	.73 (1.89)	1	487. (13.80)
			2	342. (9.67)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ..... INITIAL VALUE SPILLWAY CREST TOP OF DAM

ELEVATION	800.00	800.00	801.90
STORAGE	22.	22.	26.
OUTFLOW	0.	0.	230.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	802.10	.20	26.	533.	.42	40.92	40.33

PLAN 2 ..... INITIAL VALUE SPILLWAY CREST TOP OF DAM

ELEVATION	800.00	800.00	801.90
STORAGE	22.	22.	26.
OUTFLOW	0.	0.	230.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	802.27	.37	27.	355.	3.50	41.00	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW.CFS	MAXIMUM STAGE.FT	TIME HOURS
.20	533.	701.3	41.00

PLAN 2 STATION 3

RATIO	MAXIMUM FLOW.CFS	MAXIMUM STAGE.FT	TIME HOURS
.20	355.	700.8	41.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW.CFS	MAXIMUM STAGE.FT	TIME HOURS

.20	506.	611.6	41.33

PLAN 2 STATION 4

RATIO	MAXIMUM FLOW.CFS	MAXIMUM STAGE.FT	TIME HOURS
.20	347.	611.4	41.50

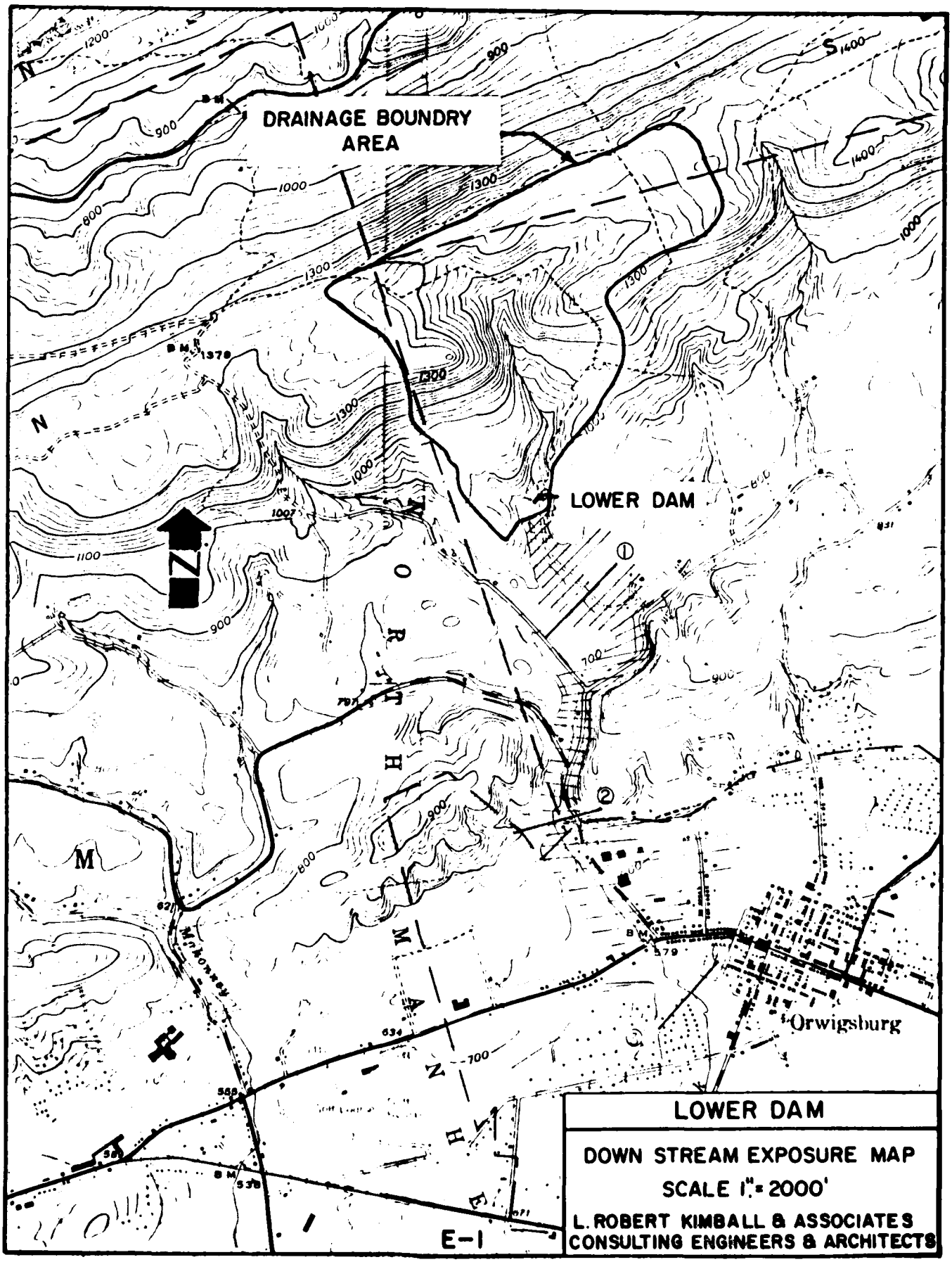
PLAN 1 STATION 5

RATIO	MAXIMUM FLOW.CFS	MAXIMUM STAGE.FT	TIME HOURS
.20	487.	562.0	41.67

PLAN 2 STATION 5

RATIO	MAXIMUM FLOW.CFS	MAXIMUM STAGE.FT	TIME HOURS
.20	342.	561.4	41.83

APPENDIX E
DRAWINGS

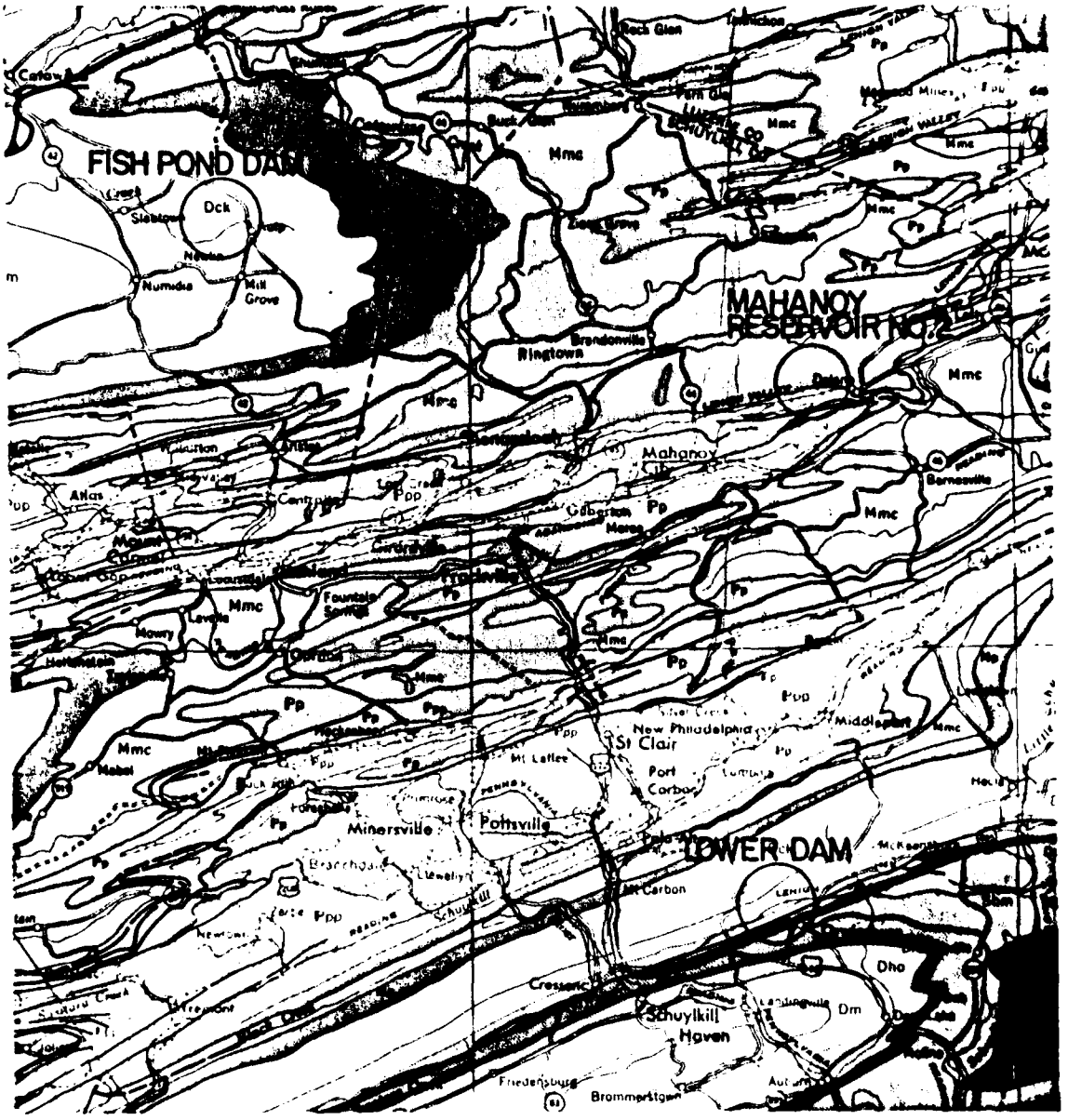

DRAINAGE BOUNDRY AREA
LOWER DAM
NORTH MAIN
Orwigsburg
LOWER DAM
DOWN STREAM EXPOSURE MAP
SCALE 1" = 2000'
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
E-1

APPENDIX F
GEOLOGY

General Geology

Lower Dam lies within the Appalachian Mountain Section of the Valley and Ridge Physiographic Province. This area is characterized by overturned and assymetric folds, local shearing, and large, low-angle thrust faults. A major fault zone, trending to the northeast, passes about one mile south of the dam.

The bedrock underlying the dam consists of the Devonian aged Catskill formation. This is a complex unit consisting of sandstones, siltstones, shales, and conglomerates. The usually well developed beds range in thickness from less than one foot to over fifteen feet. The well developed and closely spaced joints in the siltstones and shales are steeply dipping and form blocking or platy patterns. The formation is moderately resistant to weathering, except for the shales, which disintegrate rapidly. The foundation stability for heavy structures is good if excavated to sound material and the shales and siltstones are kept water free.

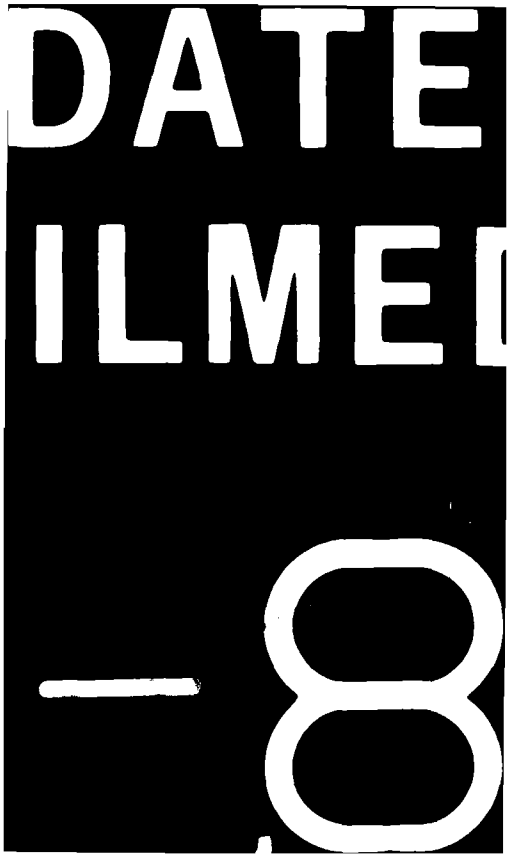


GEOLOGICAL MAP OF THE AREA AROUND FISH POND DAM, LOWER DAM AND MAHANOY DAM NO. 2.

Pp — Pottsville Group

Dck — Catskill Formation

SCALE 1 : 250,000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